

AD-A276 750



2

1993  
Executive Research Project  
DIS

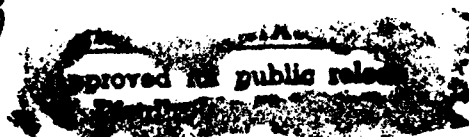
# Manufacturing in America: Crisis and Opportunity

Lieutenant Colonel  
Cleve B. Pillifant  
U.S. Marine Corps

*Faculty Research Advisor*  
Mr. Gerald W. Abbott

DTIC  
ELECTE  
MAR 09 1994

94-07757



The Industrial College of the Armed Forces  
National Defense University  
Fort McNair, Washington, D.C. 20319-6000

94 3 8 167

DTIC QUALITY INSPECTED 5

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE

## REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS									
2a. SECURITY CLASSIFICATION AUTHORITY N/A			3. DISTRIBUTION/AVAILABILITY OF REPORT Distribution Statement A: Approved for public release; distribution is unlimited.									
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE N/A												
4. PERFORMING ORGANIZATION REPORT NUMBER(S) NDU-ICAF-93- DIS			5. MONITORING ORGANIZATION REPORT NUMBER(S) Same									
6a. NAME OF PERFORMING ORGANIZATION Industrial College of the Armed Forces		6b. OFFICE SYMBOL (If applicable) ICAF-FAP	7a. NAME OF MONITORING ORGANIZATION National Defense University									
6c. ADDRESS (City, State, and ZIP Code) Fort Lesley J. McNair Washington, D.C. 20319-6000			7b. ADDRESS (City, State, and ZIP Code) Fort Lesley J. McNair Washington, D.C. 20319-6000									
8a. NAME OF FUNDING/SPONSORING ORGANIZATION		8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER									
8c. ADDRESS (City, State, and ZIP Code)			10. SOURCE OF FUNDING NUMBERS									
			<table border="1"> <tr> <td>PROGRAM ELEMENT NO.</td> <td>PROJECT NO.</td> <td>TASK NO.</td> <td>WORK UNIT ACCESSION NO.</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table>		PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.				
PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT ACCESSION NO.									
11. TITLE (Include Security Classification) <i>Manufacturing in America : Crisis &amp; opportunity</i>												
12. PERSONAL AUTHOR(S) <i>Clive B. Pillifant</i>												
13a. TYPE OF REPORT Research		13b. TIME COVERED FROM <u>Aug 92</u> TO <u>Apr 93</u>	14. DATE OF REPORT (Year, Month, Day) April 1993	15. PAGE COUNT <i>27</i>								
16. SUPPLEMENTARY NOTATION												
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)									
FIELD	GROUP	SUB-GROUP										
19. ABSTRACT (Continue on reverse if necessary and identify by block number)  SEE ATTACHED												
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified									
22a. NAME OF RESPONSIBLE INDIVIDUAL Judy Clark			22b. TELEPHONE (Include Area Code) (202) 475-1889	22c. OFFICE SYMBOL ICAF-FAP								

## **Abstract**

**Title:** Manufacturing in America: Crisis and Opportunity

**Author:** Lieutenant Colonel Cleve B. Pillifant, U.S. Marine Corps

**Summary:** American manufacturing has gone from undisputed world leader to a troubled industry under economic siege from our international competitors. U. S. productivity, innovation, investments, and the work force have been scrutinized and found wanting by a variety of groups, agencies, and individuals. This student research paper highlights the challenges facing American manufacturers in today's global economy. Future trends are identified that will shape the industrial and government response to remedy the crisis. The paper concludes by outlining five industry actions which must be taken and five complimentary government actions to reinvigorate America's industrial progress.

1993  
Executive Research Project  
DIS

# Manufacturing in America: Crisis and Opportunity

Lieutenant Colonel  
Cleve B. Pillifant  
U.S. Marine Corps

*Faculty Research Advisor*  
Mr. Gerald W. Abbott



Accession For	
NTIS	CRA&I <input checked="" type="checkbox"/>
DTIC	TAB <input type="checkbox"/>
Unannounced <input type="checkbox"/>	
Justification _____	
By _____	
Distribution /	
Availability Codes	
Dist	Avail and/or Special
A-1	

The Industrial College of the Armed Forces  
National Defense University  
Fort McNair, Washington, D.C. 20319-6000

## **DISCLAIMER**

This research report represents the views of the author and does not necessarily reflect the official opinion of the Industrial College of the Armed Forces, the National Defense University, or the Department of Defense.

This document is the property of the United States Government and is not to be reproduced in whole or in part for distribution outside the federal executive branch without permission of the Director of Research and Publications, Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C. 20319-6000.

## Introduction

American manufacturing burst upon the international scene in 1851. The London Crystal Palace Exhibition of that year, the first World's Fair, heralded a new manufacturing contender. United States companies garnered many medals for design and products. What is more important, the world took notice of the novel manufacturing capability of this relatively new nation.

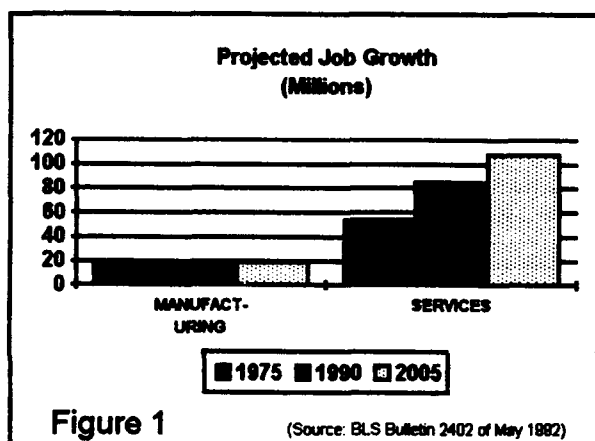
The century following the exhibition saw the United States rise to preeminence in world manufacturing. *Made in the USA* became the epitome of quality and desirability as American products became standard the world over. This began to change as other nations' manufacturing might began to penetrate traditional American markets, including the American homeland. Market share losses began slowly. The market was huge, a few inroads here and there were not particularly alarming. The first Japanese incursions into the market place were often the butt of jokes about their inferior quality and flimsy copies of superior American products. No one is laughing any more.

What began as a small erosion turned into a swift flowing river as the world (and America) turned away from the *Made in America* label and began shopping in Japan and other market places. Manufacturing in America has paid a heavy price. Jobs, the American standard of living, and world leaderships hang in the balance. The American response so far has been slow and ineffective. America's share of the world market in many commercially important sectors continues to dwindle (EG; machine tools, automobiles, consumer electronics). In other sectors we are fighting to maintain market share against an ever increasing number of global competitors. All this while our American economy is struggling to recover from a recession.

This paper explores why many believe a crisis exists and recommends policy changes to facilitate a recovery of American manufacturing.

### Where have all the workers gone?

In 1920 over half of the American work force was engaged in manufacturing activity. By September 1992 only 16.7 percent of Americans working full time were employed in manufacturing while 76 percent were employed in services-producing industries.<sup>1</sup>



This shift in job sectors illustrates that job growth in recent years has not been in the manufacturing industry. Between 1981 and 1986 almost 2.55 million Americans lost their manufacturing jobs. Plant closures and work force reductions have become frequent headlines. Corporate giants IBM, General

Motors and Boeing recently announced sizable layoffs and plant closures.

Despite these plant closures and work force reductions, the number of those employed in manufacturing has grown 4.3 percent since 1975. Meanwhile, employment in the service-producing sector increased 56 percent during this time span. Figure 1 indicates the situation is not going to get much better in the future. The Bureau of Labor Statistics projects that by the year 2005 service jobs will grow another 27 percent while manufacturing jobs will decline by 4.3 percent.<sup>2</sup> The fastest growing service occupations are not related to manufacturing activity. The greatest job growth is in health care, the legal field, and other personal service occupations. In the face of intense global competition, U.S. manufacturing companies are either shrinking or exiting at an alarming

rate. One sector serves as a grim example, the machine tool industry. In 1982 there were 865 cutting tool company's doing business in the United States. By 1987 that number had fallen by over 50 percent to 381 companies with a 47 percent drop in the number of employees but only a 28 percent decrease in output. In the metal forming sector a similar situation exists, from 435 companies in 1982 to 196 companies in 1987 with a 29 percent drop in the number of employees but only a 3 percent drop in output. This is both good news and bad. While companies and jobs are disappearing productivity is increasing. However, here is one example of the two edged sword of productivity.

### **Competition or Protection?**

As global competition increases, calls for protectionism are heard. Accompanying these calls are claims of "unfair" actions by competitor nations. Usually, these "unfair" actions consist of lower prices to Americans. U.S. manufacturers would have us believe that tariffs or quotas on these imported goods are necessary to "level the playing field". This leveling is necessary, in their view, because our competitors receive government subsidies or support to sell at cheaper prices. But, is this really the cause? Why aren't American goods more competitive? One measure of international competitiveness is the productivity of the nation's work force. Recently, much concern over American productivity has surfaced. America's productivity is often characterized as "sluggish". As in the machine tool example, gains in productivity can come at the expense of jobs. Do American firms need protection or a swift kick in their productivity?

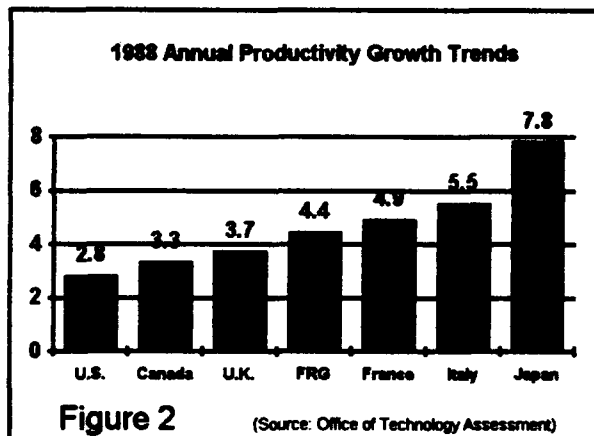
### **Post World War II Productivity**

American dominance in the world market place following World War II was virtually unchallenged. The MIT Commission on Industrial Productivity identified five pillars upon



which our advantage rested; largest market in the world, superior technology, skilled workers, national wealth, and a cadre of talented managers. Another factor is worthy of consideration; a vast industrial capacity and infrastructure left unscathed by war damage. With Europe and the Orient in virtual ruin, the United States had a huge competitive advantage. This rapidly changed as our competitors rebuilt their factories and mobilized their work force. American manufacturing turned to high volume, low cost production methods to help our former allies and enemies regain their pre-war productive efforts. England, France, Italy, Germany, and Japan began the slow process of replacing their production capability. Now they had the successful American production model on which to build. They watched, waited, learned, and improved the processes devised in the laboratories and applied on the production floors of American industrial giants.

### American Productivity Today



While the American worker is still the most productive in the world, American productivity increases are being surpassed by many of our global competitors. We are losing our productivity advantage. Canada, Britain, Germany, France, Italy, and Japan all post annual productivity gains above that of the

United States. Figure 2 illustrates the extent to which the United States is being out-performed when it comes to this important measure of industrial strength.<sup>3</sup> What has happened to American productivity? Why are our rates of improvement so much less than other nations? Some would say it's because the other nations had so far to go. However, this explanation is too easy. Other evidence suggests specific reasons.

The Massachusetts Institute of Technology Commission on Industrial Productivity found six patterns of weakness in American manufacturing during their two year study of ten selected industries.<sup>4</sup> First, American firms are holding to outmoded strategies of inflexible mass production. This involves high volume, low cost, and standard items, much like Henry Ford's marketing line of old, "They can have any color they want.... as long as it's black".

Second, American industry has a short-term time horizon. Governments, financial institutions and business education are oriented towards quarterly performance and a quick turn on investment. The MIT Commission found too much attention on short term profits and not enough on longer term competitive position.

Third, more emphasis on product over process creates technological weakness in development and production. While we lead the world in inventing new products, others beat us to the production floor and the market place. We suffer from a failure to design an easily producible product with quality built-in. One executive told the MIT team; *"I don't want intelligent people involved in manufacturing."* Evidently, they didn't want them in management either.

Fourth, people are neglected, and not only in the work place. Basic education is lacking as is meaningful job training. The MIT study concluded that "... many U.S. companies still view labor as a cost to be minimized rather than a precious asset to be cultivated."

Fifth, failure to cooperate inside the company and externally; with other companies, the government, and suppliers. Instead of working together to forge a more competitive force, each works at cross-purposes to the other. Quality, cost, and competitive position are sacrificed.

Lastly, government and industry are not working together to meet the challenges ahead. Neither listens to the other, neither understands the other very well, and neither trusts the other very much.

These weaknesses have contributed to an overall decline in American productivity and industrial competitiveness that characterizes our industries of today.

### Innovation is Dependent on Research and Development

Productivity can only be improved by attacking the numerator or the denominator of the equation: output/input. Either output is increased or the input required to achieve the same (or higher) output is decreased. Both methods are dependent on finding new ways to improve the product or the process. The United States' huge investment in defense is one reason why our critics say that commercial sector R&D has fallen behind.

Japan and West Germany would be expected to have low expenditures in defense R&D

TABLE 1 1989 R&D EXPENDITURE COMPARISONS		
COUNTRY	% R&D ON DEFENSE	% GNP ON NON-DEF R&D
UNITED STATES	65.5	1.9
UNITED KINGDOM	45.5	1.6
FRANCE	37.0	1.8
W GERMANY	12.8	2.8
JAPAN	5.1	3.0
Source: National Science Foundation		

given their post war status and limitations. U. S. expenditures are \$79 billion in constant 1982 dollars compared to Japan's \$45.5 billion and West Germany's \$20.9 billion. However, the fact that our competitors are devoting a larger share of their Gross National Product to non-defense research and development is one reason for their

growing economies. Recent attention has centered on the focus of industrial R&D effort funded by the U. S. Much of this effort is devoted to product development and not the manufacturing process.

Our chief rival, Japan, devotes a much larger portion of their R&D on process improvements. They spend two-thirds of their industrial R&D on process compared to the U. S. one-third.<sup>5</sup> One U. S. Executive observed that while the U. S. wins Nobel prizes, the Japanese don't care. "They just ship our Nobel prize back to us... by the boatload."<sup>6</sup> The video cassette recorder (VCR) is a prime example of U.S. supremacy in invention but failure to bring a product to market. The Japanese were able to mass produce and developed the market for this product. It showcases their relative strength in global competitiveness. It also demonstrates a U.S. weakness in that part of the product life cycle that results in jobs, economic growth, and industrial strength. American industry, government, universities, and laboratories lead the world in invention and technical innovation. However, the Japanese are much faster in converting these inventions into low cost and high quality products. While it takes American and European car manufacturers over five years to bring a new model from design to full-scale production, the Japanese can do it in three and a half years.<sup>7</sup>

A 1990 study by Drs. Morbey and Reithner confirmed previous findings that a strong relationship exists between R&D and a company's performance and profitability.<sup>8</sup> The study reached three conclusions that demonstrate R&D is vital to company performance.

1. There is a strong direct relationship between R&D intensity (R&D per sales) and subsequent growth in sales.

2. There is a strong relationship between R&D expenditure per employee and subsequent company profit margin.

3. There is a strong relationship between R&D expenditure per employee and subsequent company profit margin.

These conclusions should not be surprising to anyone. The difference in R&D emphasis has worked to our competitors' advantage. American emphasis on technological superiority is admirable. However, it has led to over-emphasis on product development at the expense of process improvement. In today's global market place, success is measured more in terms of who can get the product to the market first.

### **The Patent Scoreboard**

If we examine patent activity as a measure of R&D effort, some interesting trends develop. Patent applications from foreign inventors surpassed American inventors for the first time in 1987 and the gap is increasing. Japanese patent applications doubled in the decade of the 80's. From 12 percent in 1980 they rose to 21 percent in 1989.<sup>9</sup> Japanese patents consist of high tech and commercially lucrative technologies such as photocopying, photography, dynamic information storage and retrieval, television, motor vehicles, and internal combustion engines. U. S. activity runs toward biotechnology, pharmaceuticals, communications, chemicals, wells and mineral oils classes. Japanese patent interest is in areas of little American activity. The reverse is also true which gives the impression that each country has chosen the technological fields in which they are willing to compete. Japan recently announced Plan 21, an ambitious plan to become the world's leading provider of pollution control systems by the year 2100. In one stroke we see the Japanese targeting a particular technology as well as marshaling government and industrial forces to

reach a long term goal. Initial results are quite favorable. They recently sold a concrete plant to the Chinese with impressive air pollution control technology. The source of this technology? The United States!

Meanwhile, other Pacific-rim countries are joining the fray. Taiwan is concentrating on communications, semiconductor manufacturing, and internal combustion engines. Korea is heavily into electrical products and components and is a major U. S. supplier of computers and peripherals. The list of competitors is growing every day. America is increasingly pressured by established and emerging nations.

### **Investment as a Barrier to Innovation**

American steel stands as a stark reminder of what happens to an industry that fails to

invest in itself. The northeast United States is littered with obsolete, shut down integrated steel plants that stand as bitter testimony to the consequences of suspended capital investments. It is difficult to imagine the logic that leads to the failure to replace equipment or advance the technological capability of American steel producing capability. Was it greed, complacency, or just plain neglect in the boardrooms of America? Weighted down by a national deficit and with capital market obsession with

**TABLE 2     1987 CAPITAL EXPENDITURES PER WORKER**

SIC	SIC TITLE	EXP PER WORKER
3571	ELECTRONIC COMPUTERS	\$22,384
3674	SEMICONDUCTORS	21,977
3711	MOTOR VEHICLES	17,501
3761	GUIDED MISSILES	13,057
3721	AIRCRAFT	7,435
3743	RAILROAD	4,119
3542	MACHINE TOOLS, FORMING	3,586
3541	MACHINE TOOLS, CUTTING	3,357
3713	TRUCKS AND BUSES	3,062
3731	SHIP BUILDING AND REPAIR	3,017

SOURCE: 1990 ANNUAL SURVEY OF MANUFACTURES

short term return, America seems unable to match its foreign competitor's investment rate. While each business is different, cyclic patterns of investment exist with a noticeable decline beginning in the late 1980's. Table 2 lists the capital expenditures for selected industries in the last Survey of Manufactures. It shows one measure of investment and how it varies among the different sectors. While success may not depend entirely on this measure, it is interesting to note that the top two sectors are those that are doing remarkably well in the global market and those at the bottom are having difficulty. The real question is are those in the middle going to be competitive ten years from now at their current rate of investment?

In 1967, Dr. Lou Rader, Computer Division Vice President for General Electric, conducted a review of leading car manufacturers.<sup>10</sup> He found that General Motors, the world's undisputed leading auto manufacturer, had an average plant and equipment investment of \$31,000 per employee. He compared that to the investment of VW (\$28,000), Fiat (\$12,000), and Simca (\$8,000). Another auto maker figured prominently on Dr. Rader's list, a relative unknown foreign maker with a per-capita investment of \$29,000. Dr. Rader observed, "Watch out for that one." The auto maker was Toyota and the rest is history.

High cost of capital is frequently blamed for lack of investment in the U. S. Comparisons show that Japanese companies do have an advantage here. Certainly, the federal deficit and a low personal saving's rate does not allow for much available capital in the U. S. It is also true that a part of the Japanese business culture includes investment for the future. There, not everything is tied to the almighty rate of return and a specified pay back period. What helped the Japanese close the gap with American productivity by 20 per cent from 1982 to 1990 is a capital-formation-rate of 30% of GNP compared to our 17.5%. Even Europe achieved a 20% rate to exceed that of U. S. industries.<sup>11</sup> One explanation of U. S. performance is the view that our capital budgeting system deters innovation. Dr. Carliss

Baldwin, the William L. White Professor of Business Administration at the Harvard Business School, found in her research that; "...discounted cash flow measures do not value commitments to innovate in advance of the competition."<sup>12</sup> She goes on to conclude that firms who stick to the usual "rules of thumb" will consistently postpone innovation in favor of an existing product cash flow. U. S. firms will avoid "cannibalizing" current products because they do not look farther into the future and seize an opportunity because of *short term* goals. They fail to see that innovation today may very well protect against future market entry by competitors.

It would appear clear that the American financial and tax system encourages consumption while discouraging investment and stands as a barrier to innovation.

### **Educating our Work Force**

Remember the executive cited earlier who did not want intelligent people on the work floor? He must also serve on a local school board. Few developed countries spend more on their pre-college students than does the United States. Yet these same students do poorly in standardized tests compared to other nations. Scholastic Aptitude Test (SAT) scores and other performance indicators show a decline that began in the mid-1960's.<sup>13</sup> High school completion rates have plateaued at 75 percent, 50 per cent of our high school graduates don't enroll in college, and 23 million Americans are functionally illiterate with 65 per cent of these having a reading level between fifth and ninth grade.<sup>14</sup>

No topic is more hotly debated than what is wrong with the American educational school system. Recent studies indicate that educational inputs; teacher-pupil ratio, teacher education/salary/experience, and expenditures per pupil have little relevance on the quality of education.<sup>15</sup> Instead, the current study emphasis is on the educational process



itself. The popular notions that "more" is better are being debunked in the face of systematic study of student performance and the educational process that produces successful students. American firms are increasingly having to train their new employees in science and math in order for them to work with the sophisticated machinery that dominate the work place today. Bureau of Labor projections are that by the year 2000 nearly one third of new jobs will require a college education. Demographic studies project a 25 percent decline in the number of college-age students that could create a labor shortage. This will force companies to hire less qualified individuals and incur greater cost to bring them up to standard. Costs that will be added to the price tag of each item produced. Industry already spends \$210 billion on formal and informal training. One survey reports that by the end of 1993, 93 per cent of the nation's largest companies will be providing basic workplace skill training.<sup>16</sup>

Despite the growing need for jobs in the service sector and the importance of a college education, craftsmanship still has an important place in our current workplace and in the future. It is sobering indeed to discover that out of 35 million blue-collar workers there are only 263,000 registered apprentices.<sup>17</sup> In 1989, 2 percent of American high school students became apprentices compared to 66 percent in Germany.

The German "dual system" has been the source of study, praise, and condemnation. Skilled artisans are as vital to an industrialized nation as funding. Yet in this country, vocational education is frequently disdained in favor of more "intellectual" pursuits. High school guidance counselors are loath to recommend vocational education to any student because a college education means higher earnings. A 1987 study by the Bureau of Labor Statistics found that college graduates earn an average of \$31,029 per year versus \$18,902 by a high school graduate. Consequently, many states are in a situation similar to Pennsylvania where the average age of metalworkers is about 57.<sup>18</sup> Half of these workers

are expected to retire by the end of the 90's and not many youngsters are ready to step up. With an average annual salary of just over \$25,100 in 1990, there are more appealing jobs than metalworking. Auto mechanic programs are bulging but trade school metalworking program openings are hard to fill. Even with Department of Labor projections that 122,000 metal and plastics-working machine operator jobs will be lost by 2005, replacement workers are needed.<sup>19</sup> To meet this labor requirement, many manufacturing intensive states are starting apprenticeship programs like that in Pennsylvania. Colleges, high schools and local governments are starting to work in partnership to train non-college bound students for blue-collar jobs in industry. The American Association of Community and Junior Colleges started Tech-Prep to help answer the need for apprentices in the workplace. This program combines two years of vocational education with two years of high school. Over 400 community colleges have instituted Tech-Prep on their campuses. The Pennsylvania Youth Apprenticeship Program differs in that it has corporate sponsors who offer the participants an opportunity to actually work in a production setting three days a week. The students attend non-traditional high school classes the other two days a week. While not guaranteed a job, these Pennsylvania students are gaining experience that will make them competitive when high school is completed.

### **Future Trends**

The MIT Commission on Industrial Productivity identified three trends that will affect our productivity strategies.

- **Economic activity will continue to become more international. National boundaries become increasingly irrelevant in tomorrow's market place. Free**

Trade agreements and the General Agreement on Trades and Tariff (GATT) will herald an end to obstructions to commerce between cooperating nations.

- **The market place is becoming increasingly more sophisticated. Demands for high quality goods are being made by ever more knowledgeable consumers. Customized products to meet the customers specific desires are becoming more common.**
- **The rapid pace of technological change will continue. This will permit manufacturers to respond to changing markets and produce the customized products required by the customer. The Commission's report talks of *"totally flexible production systems combined with the power, precision, and economy of modern production technology."***

While there are many concerns over the future of manufacturing in this country there is also hope. The very fact that there is so much concern is itself a good sign. One must first acknowledge a problem exists before correction is possible. There are other positive signs. We still have the world's largest economy and it is showing signs of growth few suspected were possible. Action to deal with the deficit is at long last being taken by our elected leaders. The age of consumption may soon give way to the age of investment if our new President's economic plan is successful. As political rhetoric gives way to specific action America can begin the road back to industrial recovery.

### **What Industry Can Do**

The MIT Commission identified five imperatives that encompasses most of the literature on industry actions required.

1. Focus on the new fundamentals of manufacturing. Short term financial performance has been placed ahead of developing, producing, and marketing the product. Effective use of technology in manufacturing provides the ability to customize products and achieve process flexibility. Concentration on process improvement rather than product differentiation will lead to more capable manufacturing.

2. Cultivate a new economic citizenship in the work force. Free human resources to achieve their full potential. Under this concept American "...workers, managers, and engineers will be continually and broadly trained, masters of their technology, in control of their work environment, and involved in shaping their firms' objectives."

3. Blend cooperation and individualism. Flatter organization structures and team building will facilitate the new economic citizenship. Better intra- and inter-firm relationships will pave the way towards cooperative relationships to achieve standards, enhance production, and reduce costs. The cooperative tenants of Total Quality Management are being proven in many firms around the globe. These stress the use of teaming and worker "empowerment" to attain greater productivity and quality.

4. Learn to live in the world economy. Start by learning foreign languages, cultures, and practices. Global competition will require this kind of knowledge to engage in commerce. A story heard often is the need for wheat in Europe after World War II, the U.S. had a surplus but it wasn't acceptable in Europe because they ate rye. Knowledge of the market will require knowledge of the people. In addition, this will help businesses learn of best (better) practices of manufacturing for adoption at home. The world has benefited from the ingenuity of American inventors. Conversely, the United States has shown little interest in obtaining technological ideas from other nations.

5. Provide for the future. This imperative is about investment in education, technical literacy, and adopting long term strategies in business decision making. The return on investment frenzy during the 80's is partly to blame for our present weak competitive condition. Investors will have to be led by an industry committed to the future rather than short-term profit.

### **What Government Can Do**

To facilitate industry's actions' government must become a partner with industry to resolve past issues and build a brighter future. Government can take action to help industry in each area identified by the MIT Commission.

1. Incentivize industrial process research and development. Research and development is necessary to continued technological advancement. American private firms spend two-thirds of their R&D on new products and the remaining third on new processes. The Japanese ratio is the reverse, two-thirds on process and one-third on new products. Recent history demonstrates that the firm (or country) who can get the product to market fastest with greater or equal quality and at lower cost will generate market share.

Strong basic research is necessary but it is process innovation that will win the marketing competition. A cohesive interaction with industry and tax incentives will direct R&D towards process development. The Federal Technology Transfer Act of 1986 increased federal laboratory cooperative effort with private industry. Further encouragement for industry consortia should be permitted and anti-trust laws examined for appropriateness in today's environment. Japanese firms routinely work together on such issues and to share R&D costs and responsibility. Initial American efforts have been somewhat successful

with Sematech and others. More efforts are needed to encourage university-industry cooperative R&D efforts. Consortia formation is growing. More than 200 consortia have registered with the Commerce Department since the passage of the National Cooperative Research Act of 1984.<sup>20</sup> Consortia offers risk sharing but also other advantages to participants. They can do things no single company can do: establish standards, protocols and interfaces that will accelerate a whole market, establish common qualifications for suppliers, and conduct multi-company market trials.<sup>21</sup>

2. Encourage continual job training in the work force. To create economic citizenship in the work force the workers must be continually trained in order to participate as a full member of the organization. Most work-based training is provided to managers and executives and not to rank and file workers. It is estimated by the Department of Labor that less than 10 percent of front-line workers receive training of any kind.<sup>22</sup>

Dr. Deming's enormously successful Total Quality Management program places high emphasis on worker training to achieve a high quality product. "Empowering" workers is impossible without continual training that builds a sense of ownership in their firm's product. Job training must be preceded by a quality education system that prepares workers for employment. The current educational system does not produce workers who possess the skills for today's businesses. Many firms have to provide training to recent hires to develop those skills that are desirable, skills they didn't pick up in high school. The Secretary of Labor's Commission on Achieving Necessary Skills (SCAN) spent one year finding out what skill's business owners, public employers, managers, union leaders, and workers needed.<sup>23</sup> Their report, What Work Requires of Schools (June 1991), identified five competencies (resources, interpersonal, information, systems, and technology) and a three-part foundation (basic skills, thinking skills, and personal qualities) needed for solid job performance.

The competencies ensure students enter the work force prepared for any position to include those that require high performance employees. The MIT Commission calls for rigorous standards, national examinations, increased focus on science and math, and a longer school year. These approaches are compatible and designed to deliver energetic and capable workers.

Keeping workers technically proficient is only possible through continuous education and education. The MIT Commission emphasizes special attention for women, blacks, and Hispanics because of their changing demographics and importance to the future work force.

3. Labor-management relations are typically more adversarial than cooperative. The arrival of TQM brings with it a more cooperative and mutually dependent relationship than currently experienced. Continuous innovation, frequent cooperation, and serious "teaming" of management and labor are necessary for building partnership rather than parochialism. One controversial step to improve divisional attitudes is to place limits on top executive pay. Encouraging compensation packages that include profit sharing and stock-purchase plans for front-line workers, standard in many highly successful firms, can set the standard for the executive suite. Frequent comparisons of American top executives to that of their international competitors have highlighted that reform here would greatly improve relations with workers.

4. Prepare to compete in a global economy. GATT, which has been around since World War II, and the North American Free Trade Agreement (NAFTA) are becoming reality. America must begin to eliminate trade restrictions and continue negotiations to eliminate trade barriers and ensure equal access to foreign markets. However, foreign companies should have to pay corporate taxes just as American companies pay. One

method for doing this is to impose a Uniform Business Tax. This would not only raise revenue, it would eliminate a financial disadvantage under which our businesses operate. The U. S. must take a more active role in marketing American products overseas. Trade shows held in foreign countries are frequently subsidized by the participating governments, with the notable exception of the United States. The machine tool industry frequently points out that foreign governments underwrite their competitors' exhibitions while American companies must fund their own way. Marketing American products abroad must be a combined effort of industry and government.

5. Reorient economic goals toward the long term. American government and industry must begin thinking of long term results and abandon the current emphasis on short term returns. Toward that end a series of actions must be taken to focus on longer term objectives in business and government. First, government must reduce the cost of capital to permit investment. Most pundits agree that this must begin with reducing the deficit. Next, increased personal savings are required to create the pool of capital available for business investment. The U.S. lags far behind other industrialized nations in terms of private savings. This fact, along with current banking difficulties and the federal deficit has made it costly to obtain capital. The MIT Commission points out a lower cost of capital is not the only answer to encouraging investment. Attitude and focus on long-term goals are equally important. One method to jump-start investment would be to do away with depreciation schedules and permit firms to expense capital expenditures up front as a lump sum. This would provide immediate incentive to invest heavily in equipment to enhance productivity and high quality goods. Revised tax laws to encourage long term investment in companies and discourage short term profit taking are needed. This would begin to shift expectations toward company strategies that lead to future market position that is too frequently undervalued in today's financial environment.



## **A Technology Czar?**

The President's Commission on Industrial Competitiveness and the MIT Commission encourage the creation of a technology czar to provide a coordinated and focused effort in developing and pursuing a cohesive national technological strategy. Critics say the creation of a national technology policy will require the government to pick "winners and losers." In effect, this has already occurred. Government funded research reflects the chosen critical technologies as does the Commerce Department's list of "emerging technologies". Not so surprisingly, the listing of Defense and Commerce technologies are very similar. What is needed is a consolidation of these lists into one National Technologies list for use in establishing tax, trade, and research policies that will lead American industry into the year 2000. If the Japanese are already planning for the year 2100 and picking their own "winners", can we do any less?

The President's Office of Science and Technology Policy published a Technology Policy signed by the chairmen of both the House and Senate Appropriations Committee. The document does not pick any specific technologies but outlines private and public sector actions by industry as well as local, state, and federal governments. Japan's perceived success in targeting technologies comes from a coordinated effort of the three types of cooperative organizations; research associations, traditional industrial associations, and R&D subsidy-support foundations. The U. S. has all of these. What's missing is someone or some organization to coordinate their efforts. Japanese success would indicate an American version of MITI is required to focus efforts and determine private and public sector actions to make American industry successful. What better place than in the President's Office of Science and Technology Policy?

## WORKS CITED

- <sup>1</sup> United States. Joint Economic Council. Economic Indicators: October 1992. Washington: GPO 1992.
- <sup>2</sup> United States. Department of Labor. Outlook: 1990-2005. Bulletin 2402. Washington: GPO, May 1992.
- <sup>3</sup> U.S. Congress, Office of Technology Assessment, Making Things Better: Competing in Manufacturing, OTA-ITE-443 (Washington, DC: Government Printing Office, February 1990).
- <sup>4</sup> Dertouzos, Michael L., Richard K. Lester, and Robert M. Solow. Made in America: Regaining the Productive Edge. New York: HarperCollins, 1989.
- <sup>5</sup> Ibid, page 72.
- <sup>6</sup> "A Tighter Focus for R&D." Business Week Quality 1991 Special Issue: 170.
- <sup>7</sup> U.S. Congress, Office of Technology Assessment, Making Things Better: Competing in Manufacturing, OTA-ITE-443 (Washington, DC: Government Printing Office, February 1990).
- <sup>8</sup> "How R&D Affects Sales Growth, Productivity and Profitability." Research and Technology Management May-June 1990: 11.
- <sup>9</sup> National Science Board, Science & Engineering Indicators - 1991. Washington, DC: U. S. Government Printing Office, 1991. (NSB 91-1).
- <sup>10</sup> "A Better Way to Spur Manufacturing Investment." Manufacturing Engineering August 1992: 280.
- <sup>11</sup> Ibid
- <sup>12</sup> "How Capital Budgeting Deters Innovation - and What to do About it." Research and Technology Management November-December 1991: 39-45.
- <sup>13</sup> Chubb, John E. and Eric A. Hanushek. Setting National Priorities: Policy for the Nineties. Ed. Henry J. Aaron. Washington, D.C.: The Brookings Institution, 1990.
- <sup>14</sup> "Training Today's Work Force for Tomorrow." Quality August 1990: 30-32.
- <sup>15</sup> Chubb, John E. and Eric A. Hanushek. Setting National Priorities: Policy for the Nineties. Ed. Henry J. Aaron. Washington, D.C.: The Brookings Institution, 1990.
- <sup>16</sup> "Training Today's Work Force for Tomorrow." Quality August 1990: 30-32.
- <sup>17</sup> "Don't Cut the Metal Toward You...." Smithsonian March 1993: 44-55.
- <sup>18</sup> Ibid
- <sup>19</sup> United States. Department of Labor. The 1990-2005 Job Outlook in Brief. Washington: GPO, 1992.
- <sup>20</sup> "New Directions for Industrial R&D Consortia" Research and Technology Management September-October 1991: 16-26.
- <sup>21</sup> Ibid

---

<sup>22</sup> United States. Department of Labor. What Work requires of Schools: A Secretary's Commission on Achieving Necessary Skills (SCANS) Report For America 2000. Washington: GPO, 1991.

<sup>23</sup> Ibid